DARBOUX COSMOLOGICAL FLUIDS IN COMOVING TIME

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The barotropic indices and the corresponding FRW scale factors of the so-called Darboux cosmological fluids are presented in the comoving time axis, which is the natural one for the phenomenology related to the cosmological data. Some useful comments on the features of the plots are included.

In a previous work, an interesting class of Darboux cosmological fluids in closed and open FRW models of the $\Lambda = 0$ cosmology has been introduced by one of the authors.[1] However, the results have been displayed in the conformal time axis, whereas for comparison with definite cosmological data the comoving time axis is usually needed. The purpose of this letter is to present the cosmological comoving evolution of that class of fluids and add several heuristic comments on the obtained results. We plot here the comoving time dependent barotropic indices and the corresponding scale factors for open FRW universes,[2] respectively. Our general conclusions are presented in the following.

(i) For the open cases, we find that $\gamma_{-1}(t, \lambda)$ displays a single deep structure where an accelerating universe can exist, $\gamma_{-1}(t, \lambda) < 2/3$. Moreover, depending on the value of the λ parameter,[1] a negative region of limited extent may occur indicating the presence of a Chaplygin-like fluid whose origin may be due to the contribution of quantum field extended objects, such as d-branes.[3]

(ii) For the closed, matter- and radiation-dominated cases, we find a more complicated damped periodic $\gamma_{+1}(t, \lambda)$, for which the accelerating region is present only in the first period. No Chaplygin-like region occurs in these cases, which points to more stable cosmological conditions. The vacuum-dominated closed case has a Chaplygin-like (unstable) oscillatory behavior forever.

A very definite prediction of the model is that there is a single localized accelerating region (SLAR) for all types of non flat FRW universes, except for the closed vacuum case. Concerning a possible application to cosmological data,[4] this means that only the sample of supernovae with redshifts corresponding to the SLAR can show a clear-cut accelerating effect. Such behavior can be tested by means of a precise calibration of the supernovae cosmological data, which should take into account the determination of the time scale T introduced in the plots.

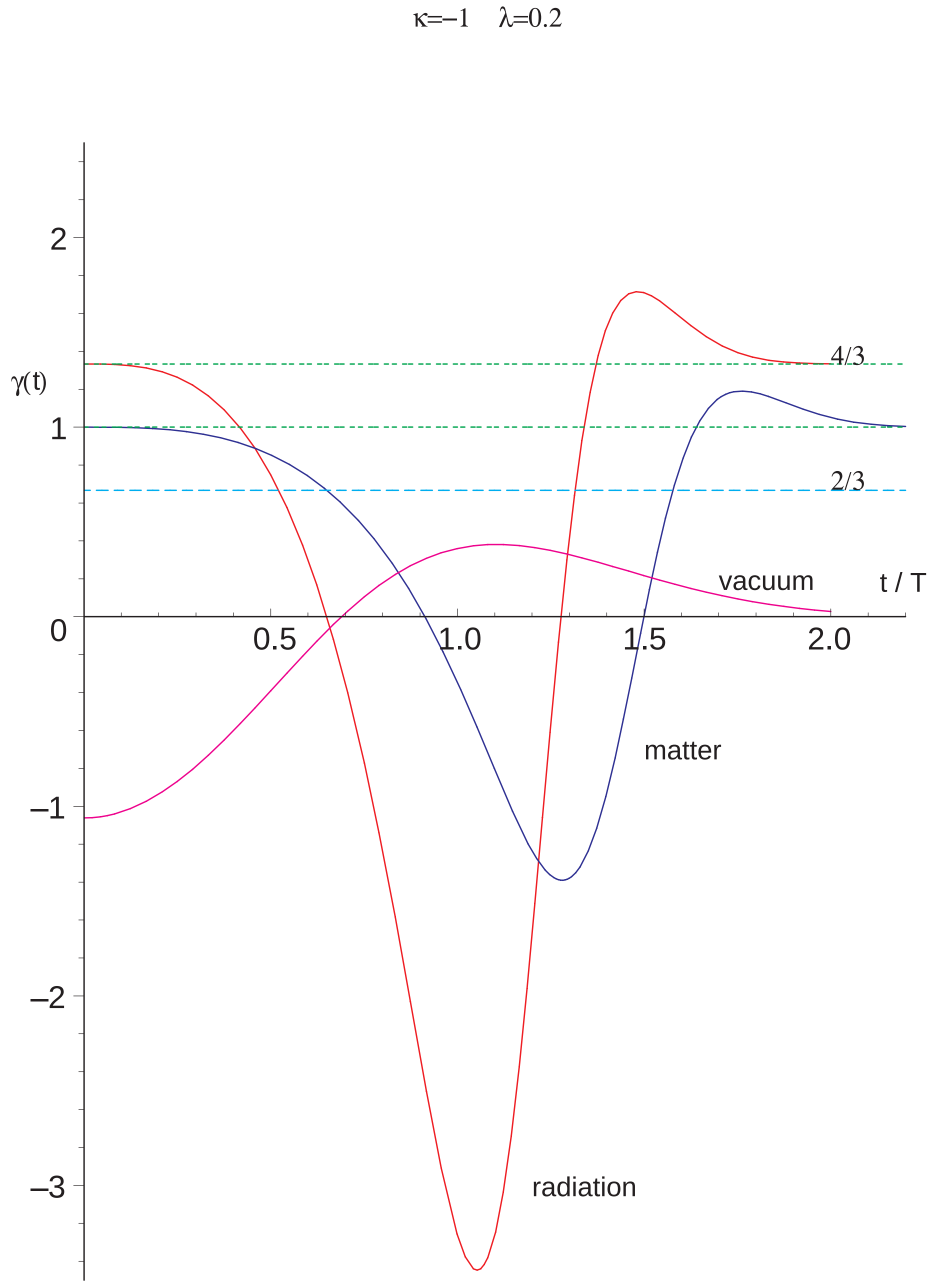

Figure 1: The time-dependent γ_{-1} index for three classes of fluids we are interested in: vacuum, radiation and matter. The plot corresponds to an open universe of $\lambda = 0.2$ along the comoving time axis. There is a small region associated to each γ_{-1} where it is negative (Chaplygin-like fluid).

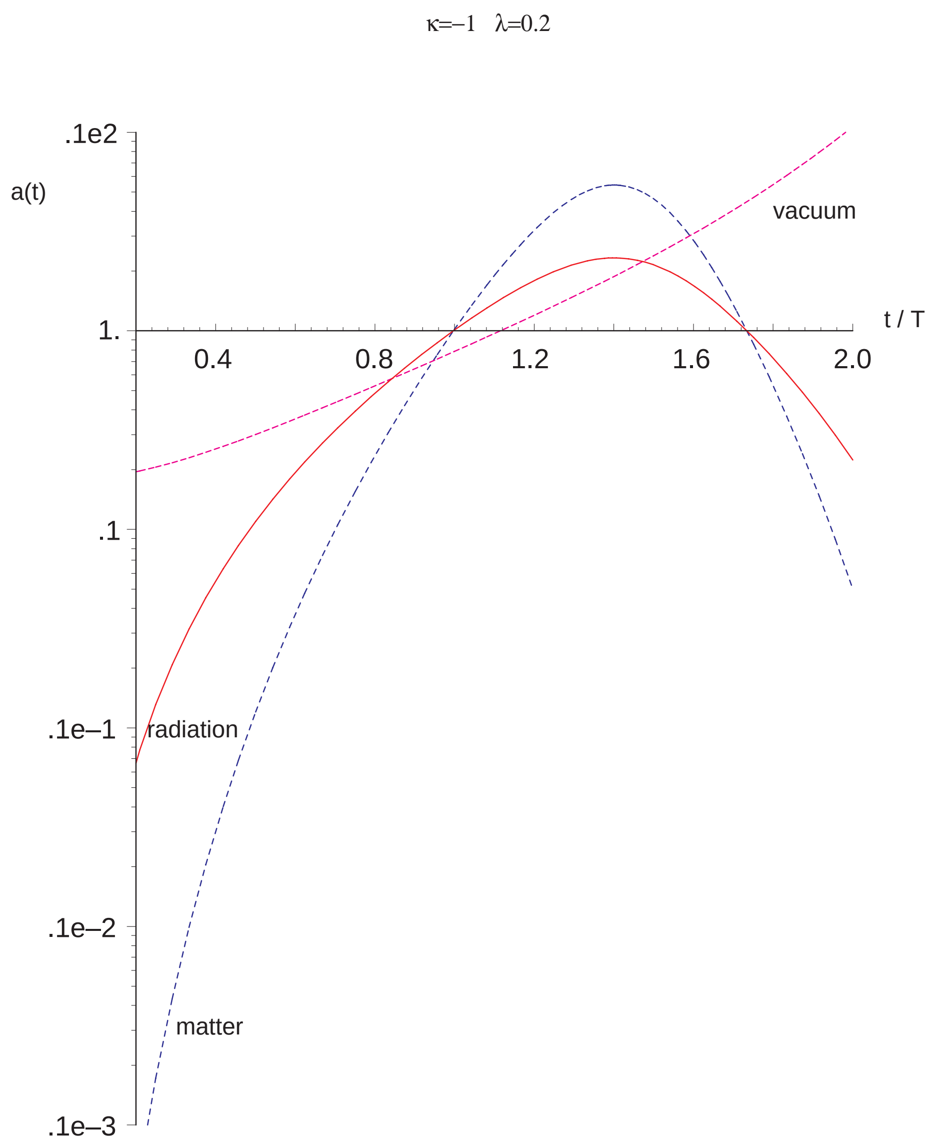

Figure 2: The scale factors corresponding to the previous cases. The universe undergoes a vacuum-dominated region followed by a radiation epoch, then by a matter era and finally ends in a vacuum phase.

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References

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